
Space Weather Technical Forecast

Issued on Monday, 05 February 2024 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: M-class flares likely throughout, with a slight chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured by GOES16, has been Moderate, with numerous M-class flares observed in the past 24 hours, most originating from AR3576 near the southeast limb. The largest was an M2.7 flare, peaking at 04/2237 UTC. There are currently eight sunspot regions on the visible disc. AR3576 is the largest region on the disc, although it remains difficult to get an accurate analysis, due to the foreshortening effect. Despite this, it does look magnetically complex with mixed polarities evident in the magnetogram imagery, with a delta configuration almost certain. A better analysis of its magnetic complexity will be ascertained once it rotates further onto the disc. Another noteworthy sunspot is AR3575 in the southwest quadrant, which is also magnetically complex, with a delta spot clearly seen. All other spots have remained fairly stable or have decreased in size. No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, started the period at slow-ambient levels, before reaching slightly elevated levels from 04/1118 UTC, peaking at 449km/s at 04/1933 UTC, before gradually declining back to slow-ambient levels. Solar wind density was mostly average to below average throughout. The IMF (Bt) was weak to moderate, peaking at +9nT, while the all-important north-south, Bz, component, ranged between +8/-7nT. The phi angle was mostly positive (towards the Sun). The above parameters may be due to a glancing blow from a CME (which left the Sun on 01 Feb), or interaction with a weak HSS from CH96/+, although this is still uncertain. The net result of the above solar wind measures was provisionally Quiet (Kp0-2) geomagnetic activity throughout, with an Unsettled (Kp3) interval observed at 04/2100-0000 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux has returned to background levels.

GOES16 high energy (greater than 2MeV) electron flux was at Normal Background to Moderate levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. At 05/0001UTC the 24-hour integrated fluence observation was 2.64e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Overall activity is most likely to be Moderate, with isolated M-class flares likely and a slight chance of an X-class flare, most likely from either AR3575 in the southwest, or AR3576 near the southeast limb.

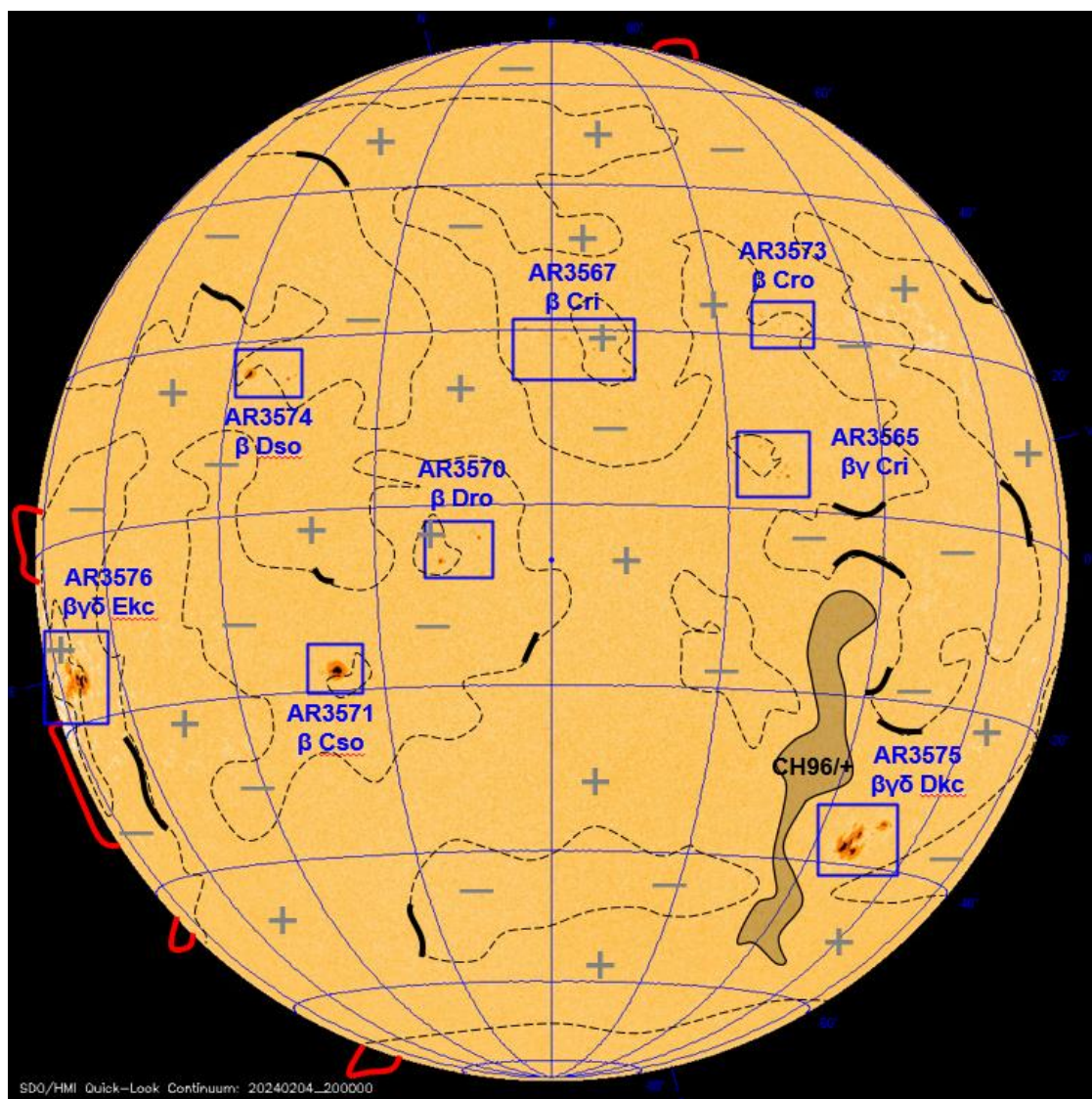
Solar Wind / Geomagnetic Activity: A CME that left the Sun at 01/0743UTC may have delivered a glancing blow earlier on 04 Feb, around 04/1010 UTC, with perhaps an interaction with a weak HSS from CH96/+, although this is uncertain. Solar winds did reach slightly elevated

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levels on 04 Feb, before declining to background levels. Solar winds should remain at mostly background levels throughout the period as no further enhancements (CMEs or HSS/CHs) currently feature in the forecast. Geomagnetic activity should be mostly Quiet throughout the period, although there remains a slight chance of Unsettled or Active early on day 1 (05 Feb) due to waning effects of either the passing glancing blow from a CME, or interaction with a weak coronal hole fast wind.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain below the S1/Minor Radiation Storm level, with a daily slight chance of exceeding the S1 threshold during the period, especially if any significant flaring occurs from AR3575 in the southwest. The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active fluence threshold considered unlikely.

Figure 1. Solar Analysis Valid 04/2000 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME which originated from a long-period C3 flare at 01/0743UTC near north-centre disc, may have arrived earlier on 04 Feb, with perhaps an interaction with a relatively weak HSS from CH96/+, although this is still uncertain. This was the only CME that featured in the forecast. Solar winds did show a steady rise to slightly elevated levels on 04 Feb, reaching between 400-450km/s, similar to previous rotation, although are now declining to background levels. No other coronal hole fast wind, or CMEs, feature in the forecast. Geomagnetic activity is expected to be mostly Quiet through the period.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

There are currently eight numbered sunspots on the visible disc. AR3576 near the southeast limb is the largest region on the disc, which is now showing some magnetic complexity, with mixed polarities evident in the magnetogram imagery, with a delta configuration almost certain. However, it is currently difficult to see its complete magnetic complexity due to foreshortening effect, although we should be able to ascertain a more accurate classification as it continues to rotate further onto the disc in the coming hours. SDO/AIA 94 imagery shows an increase in the bright flux associated with AR3576, as does SDO/AIA 171 imagery, with significant magnetic looping observed.

Figure 2: SDO/AIA 171 (left) and SDO/AIA 94 (right) shows significant magnetic looping and bright flux in the southeast, associated with AR3576.

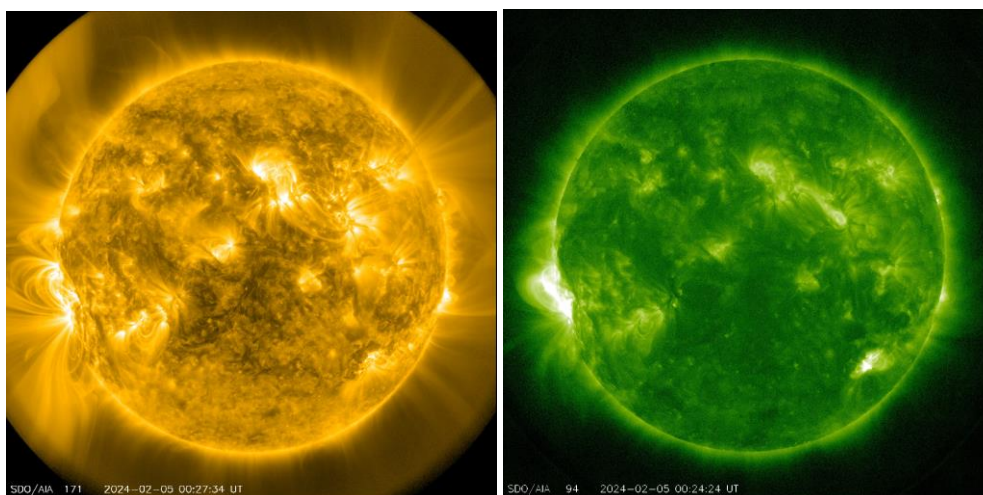


Figure 3: SDO/HMI intensitygram (left) and Magnetogram (right) shows the magnetic complexity of AR3576 in the southeast.

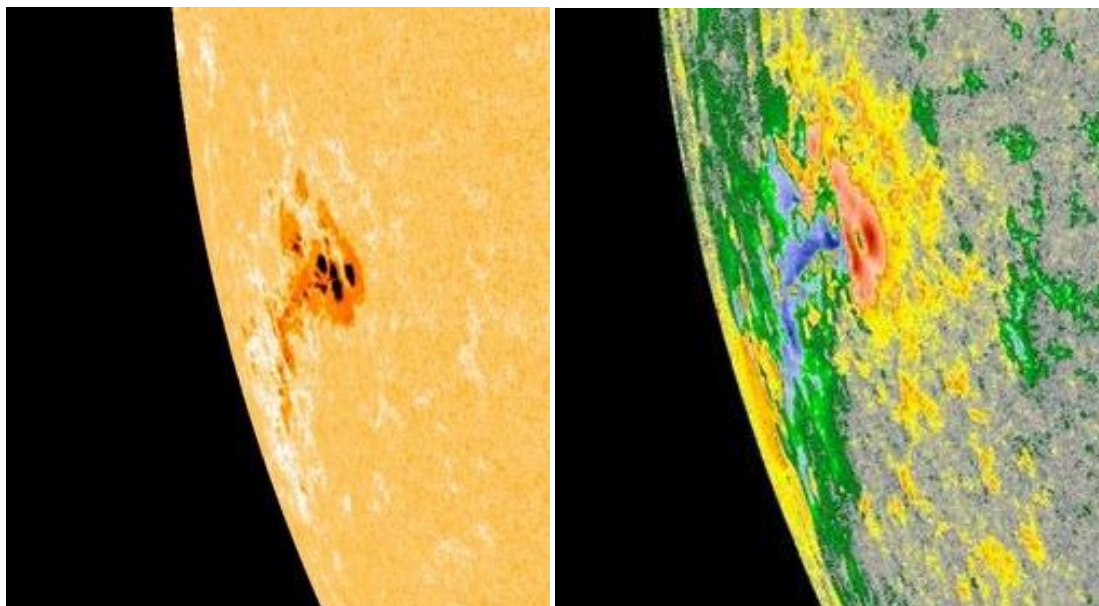
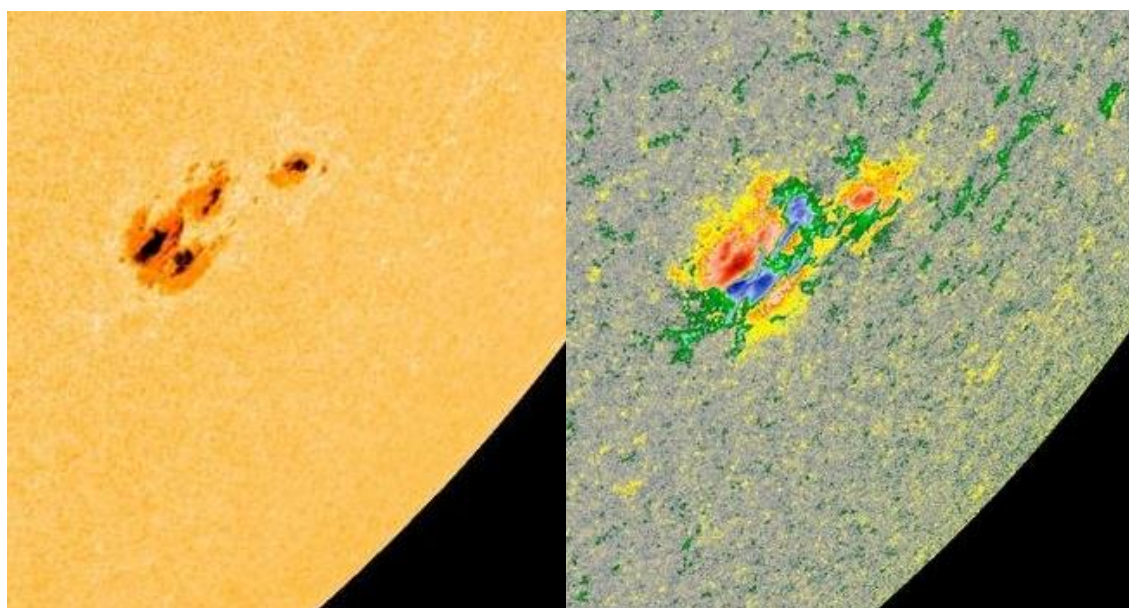


Figure 4: SDO/HMI intensitygram (left) and Magnetogram (right) shows the magnetic complexity of AR3575 in the southwest, which contains a delta spot.

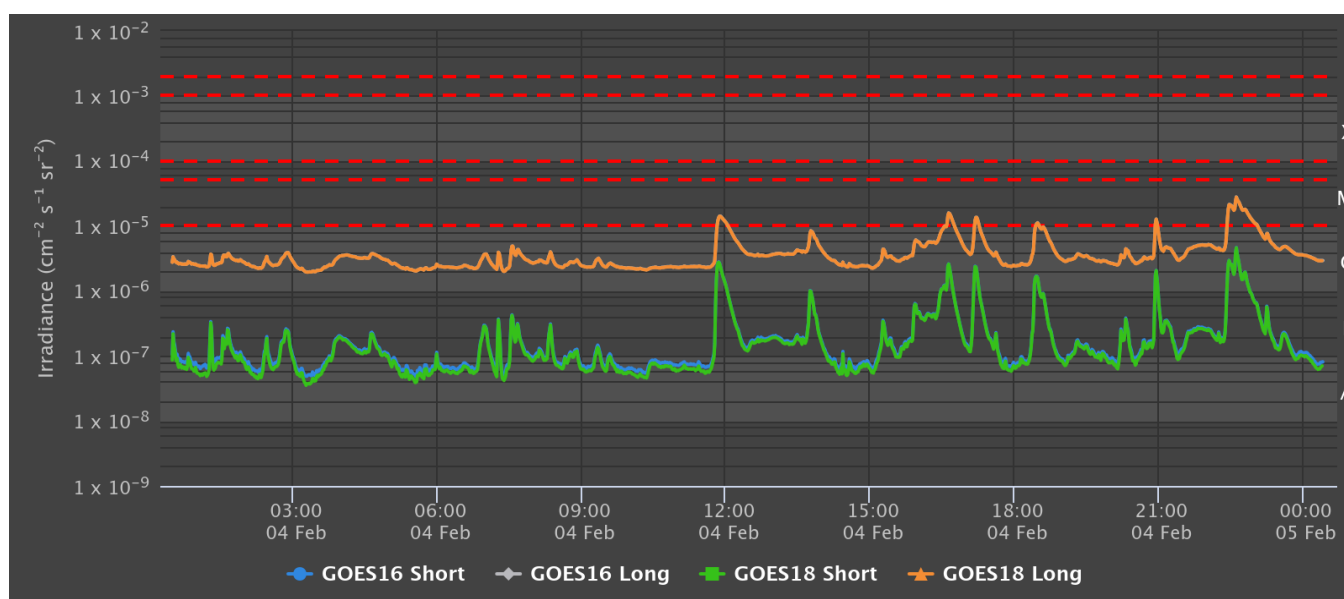


Another noteworthy sunspot region is AR3575 in the southwest quadrant, which also shows magnetic complexity, with a delta spot clearly visible. This region has also produced recent M-class flare. All other spots have remained fairly stable or have decreased in size.

None of the current regions are expected to rotate off the disc until after Day 3 (07 February) and there is no evidence for any more large regions rotating over the eastern limb, so M-class flares remain likely throughout, with a slight chance of X-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 5: GOES18 X-Ray trace – shows M-class flares originating from both AR3576 and AR3575 in the past 24 hours.



Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux has returned to background levels. There remains a slight chance of reaching S1 levels should any significant flaring occur from AR3575, which will continue to rotate into a favourable geo-effective location, approaching the southwest limb in the coming days.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	20	20	20
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has been mostly at Background levels. Any CME or HSS effects during this period are most likely to be fairly weak, and lack impetus for a significant increase in electron flux. Overall, the electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, with an overall declining trend seen in MOSWOC's REFM, which is considered to be an overall good guide at present.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1x10 ⁸	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1x10 ⁹	No	1	1	1	1

Figure 6: MOSWOC Electron fluence – observations, forecast and recurrence.

